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be a coward for ten minutes than a corpse for the rest of your life."

As a preventive and even remedy for certain bodily and mental states which are often hardly diseases but certainly are not health, cycling wisely used is unparalleled. For low spirits, for being "out of sorts," for nervous troubles, for headache, for biliousness, for dyspepsia, all generally caused by defective circulation in some part of the digestive system, it is an almost sure preventive and often a sovereign remedy. For a tendency to anæmia, chlorosis or any other impoverished blood states, steel administered in the form of a wheel is often more efficacious than in any other form.

As a stimulant to nutrition in intellectual fatigue or mental overwork, for strengthening weak lungs, for the relief of monotony and the dispersal of melancholia, as well as for many other morbid states too numerous to mention (this article is not an advertisement for any patent medicine), cycling holds the field; it carries off literary and other sedentary people to fresh scenes in fresh air, while the management of the machine demands sufficient attention to ensure change of thought without requiring sufficient to cause fatigue. Cycling has already added an undreamt of enjoyment to the lives of many. It has enabled dwellers in smoky towns to make intimate acquaintance with the blessed country. It has thus varied their lives, and it has given them fresh air, fresh interests, fresh friends (inanimate as well as animate), fresh health. It has widened their spheres of thought and action; and although the women of this country "hung fire" for some time in taking up cycling, it has already done them an amount of social, moral and physical good which is simply incalculable, and I think we may confidently expect that largely increasing numbers will take advantage of this "heaven sent" exercise for women; and as time goes on we will have greater and greater numbers of cycling English women, or as the Chinese describe them, "foreign devils riding little mules by the ears, and kicking them in the sides to make them go."

IRRITABILITY IN PLANTS.

BY SOPHIA ARMITT.

ALMOST all plant movements come into this subject; some few are purely physical and common to all structures, living or dead. There are the beautiful wave-like undulations in a field of corn or grass when a strong wind blows upon it; there are the vibrations in the teeth of a moss capsule, which are set up by a change in the degree of moisture in the surrounding air, they take place whether the plant be living or dead. From the same cause movements can be induced in the bracts surrounding the dried head of a Carline thistle. There is the "Rose of Jericho," the little desert plant that, dead and dry, rolls itself up into a ball and is blown about, with its seeds safely stowed away in the centre, till it meets with water, when it unfolds and sets free its seeds to grow in new places. The term hygroscopic has been applied to such movements in parts of plants that are due to susceptibility to dryness or moisture, and with them we have nothing to do.

The movements that are the effects of irritability take place, for the most part, very slowly, and this is, perhaps, the cause of their having been so little noticed; if they took place as rapidly in plants as in animals, the plants might appear quite as irritable as animals. But plants possess no nerves specialised for the transmission of sensation, while animals have a complicated set of structures devoted to this purpose. We remain unconscious of the movement going on always all around in the vegetable kingdom. If it could be increased about one hundred fold, our gardens and country lanes would present a strange and novel appearance. It used to be considered a mark of difference between animals and plants, that the one could move freely from one spot to another, while the other could not. There is this free movement, however, in the swarm-cells of Thallophytes, and in the creeping progressions of Diatoms. Their rates of movement are very different—the latter can traverse but one foot in from fourteen to twenty-one hours; swarm-cells, for the same distance, take only one hour, or the most rapid, only fifteen minutes. Taking rapidity in conjunction with size, the matter appears rather differently. A man in walking passes over rather more than half his length in one second; the most agile swarm-cell, in the same second, advances two-and-a-half times its own diameter, yet is this movement so slow to our large senses that, if the little plants were visible, the movement could not be seen.

Irritability has been defined as a state of unstable equilibrium, returning after every disturbance into the same condition. Again, it has been described as "the mode of reaction to stimuli peculiar to living organisms." It may be induced in many ways: by contact, by vibration, by alternation of light and of temperature. The stimulus produces a change in the molecular structure of the protoplasm, which thereby causes the escape of water from the cells to the intercellular spaces, and the cells thereupon contract. It is the protoplasm which is irritable, but it is on the elasticity, or extensibility, of the cell walls that the outward movement depends. In all the non-irritable parts of plants, the protoplasm may be stimulated without the cell wall contracting to the same extent. In Spirogyra the protoplasm contracts without the cell wall doing so, by means of the water of the cell sap escaping out through the protoplaine, in other words, the protoplasm throws the water outside itself, but not outside the cell wall, hence there is no contraction.

The stamens of many plants are notable instances of irritability. In the various species of Berberis or Mahonia the six stamens radiate outwards from the centre of the flower. A light touch on the inner side of the filament causes them to dart inwards, so that the anthers come to lie above the stigma; after this quick movement they slowly fall back and can be irritated anew. The bees which cull honey from the flowers cause these movements, they get dusted with the pollen by the inward jerk and carry it away to another flower The irritable parts of these filaments contain no intercellular spaces, but instead, abundance of intercellular substance which has the property of swelling up. A touch on the inside of the filament causes a curve along its entire length,

and Pfeffer has shown that if a filament is cut, stimulation causes a throwing out of water at the cut surface. In the blue corn-flower, and in many others nearly related to it, the irritable stamens are fixed below to the corolla tube and above to the anther tube. Between these points, in their free part, they curve outwards. If one of them is touched it straightens itself, becoming shorter; the other filaments are dragged down by the contracting one. This stimulates them and they all contract, pulling down the anther tube above, through which the style emerges. If the filaments are cut away from the corolla they can still be irritated, and made to curve to one side or to another. They contain spacious intercellular passages, and in the centre a delicate fibro vascular strand, which, like the epidermis, is strongly turgescent. The beautiful Kalmias have their anthers held fast in little pockets of the corolla, until a touch on the elastic, outwardly bent filament, sets them free. The pollinia of some orchids move through an angle of about ninety degrees, and always towards the apex of the needle, or proboscis, which carries them out of their anther. It is a minute disc of membrane to which the candicle adheres which produces this action after a short exposure to the air.

The sensitive plants, the wayside weeds of Brazil, live here only in greenhouses. The best known of them, *Mimosa pudica*, shows remarkable movements on being touched. Sachs shows how this is of utility to the plant; the first drops of rain cause all the stalks to hang down limp and the double rows of leaves to close together. In this limp and pendant state large hailstones fail to harm the delicate leaves since they yield to the blows like hanging threads, where stiffer leaves and stems are pierced or bruised by resistance. A few minutes after the storm is over they expand again unhurt, a contrast to the damaged state of the robuster plants around them.

There is another celebrated instance in the telegraph plant, *Desmodium gyrens* of Bengal, whose leaflets keep moving all the time without any touch. The irritation caused by the alternation of light and darkness is what is generally known as the sleep of plants, though there is no analogy between the sleep of animals and that of plants. Pliny mentions this phenomenon, and Linnaeus wrote an essay upon it—it is the readjustment of leaves that takes place when the darkness comes on, and the reason of it seems to be that the upper surfaces may avoid facing the zenith; opposite leaflets come together in contact that their upper surfaces may avoid the chill that occurs at night from radiation. This theory has been verified by experiments, which have shown that leaves fixed in horizontal positions during night frosts suffered more than other leaves not so fixed. There was also much difference in the amount of dew upon the pinned open and on the naturally folded leaves, the pinned open ones were coated with beads of dew, while the folded ones were almost without, showing how much colder were the fully exposed leaves.

The leaflets of clovers rise at night, those of wood sorrel fall. The latter movement we have often watched, as it occurred in oxalis leaves growing round the bases of palms and other plants in our rooms; and we have noticed that artificial light does not awaken these sleeping leaves, but we are out of the region of gas, and perhaps oil lamps are not powerful enough. In the day the leaflets of *Oxalis acetosella* are spread out flat or nearly so. It is nearly eight o'clock at this time of the year before they begin to fall, and in about an hour they are hanging vertically. It is said that these leaves move also during the day, but slightly, rising and falling four times before the great fall of night comes on, but this I have not observed. The movement of the clover leaflets is different, though their shape is almost the same, they rise and fold over each other so that the under surface only is exposed; the two side leaflets approach till their upper surfaces meet, at the same time bending downwards; the centre leaflet rises too, bending over the others and forming a roof to their closed edges. Melilotas, another trifoliate plant has another device, it places its leaflets vertical at night. The opposite leaves of the common chickweed rise at night with their upper surfaces towards each other, and the topmost pair but one closes over the terminal pair, so protecting the growing point. The cultivated Tropæolaum carries its leaves sloping towards the brightest light, but at night they bend to assume a vertical position from a point in the footstalk, about an inch below the leaf. An acacia, that is one of our room plants, present as very different appearance as a waking and a sleeping plant, folding its numerous opposite leaflets tightly together. Darwin

says in his "Movements of Plants," that all these sleeping and waking leaves are in continuous movement during the day and night, but that they move much more quickly when going to sleep and when awakening than at other times. It is troublesome, he remarks, to observe the movements of leaves in the middle of the night, but nevertheless he achieved this in a few cases, and the leaves were found to be then in constant movement. When, however, opposite leaflets come in contact, they are mechanically prevented from moving. Hence, it seems that a state of life is a state of motion. The number of genera in which the sleep of plants has been observed is about 86. As a rule all the species of a genus show the same kind of movement, but this is not invariable. There are several species of cultivated lupins in which the leaflets bend down at night, while in others they rise up—and in others, again, they make a complicated manœuvre, partly up and partly down, the shorter leaflets at the base falling, the longer ones in the centre rising, the intermediate ones twisting, whereby from a horizontal they are changed into a vertical star, with the edges instead of the blades to the zenith. It is in this family, Leguminosœ, that are the largest number of plants with noticeable sleep-movements—here, too, are the most remarkable sensitive plants.

All these noticeable movements arise from peculiar organs at the base of the petiole, or at the place where the blade meets the stalk—here lies an elongated cylinder of succulent parenchyma, which contains in its centre a flexible set of vascular bundles—movement can only continue as long as no lignification occurs in these bundles. Darkness produces an increased flow of water into this mobile organ, and more rapidly into one half, upper or lower, than into the other—hence the movement. The advent of light again causes an abstraction of water from the organ, and again more quickly in one half than the other. Yet there are many leaves having simple movements of rising and falling night and morning in which no special mobile organ exists, when the curvatures may be caused by first one and then the other side of the leaf or its petiole growing more vigorously. In this case the mobile part does not always remain the same, and such movements accelerate with growth and cease with its cessation. In the same way the flowers that open in the morning and close in the evening, owe this to the alternating growth in length of the outer and inner sides of the petals. In the first set of leaves with the mobile organs, change of temperature is quite subordinate to variation of light as the motive power. In the second set when growth is the cause of movement, temperature asserts great influence, while in the petals of flowers it is change of temperature that causes most active movement. A rise of temperature causes an outward curving of the petal and the flower opens; a cooling effects an inward curvature and the flower closes. This is well seen in Crocus, Tulip, Adonis, Ornithogallum and Colchium, all early spring or late autumn flowers, that open only when the sun shines on and so warms them.

ON OLD ENGLISH CASTLES.

By C. Fortescue Yonge.

> "The castle court . . . .
> . . . .
> He look'd and saw that all was ruinous.
> Here stood a shattered archway, plum'd with fern:
> And here had fall'n a great part of a tower,
> Whole, like a crag that tumbles from the cliff:
> And like a crag was gay with wilding flowers:
> And high above a piece of turret stair
> Worn by the feet that now were silent, wound
> Bare to the sun, and monstrous ivy stems
> Claspt the gray walls with hairy fibred arms
> And suck'd the joining of stones, and look'd,
> A knot, beneath, of snakes, aloft, a grove."
> (*Tennyson.*)

Of all the ways in which the mystery of long ago comes home to us, there are none so powerful as old historic castles. Enriched with the art of succeeding ages, they roll out for us a lasting panorama of the buried days. To find out the true story of the building and builders of a castle, taken from legends handed down from generation to generation, or from carefully cherished MSS.—what can be of deeper interest to anyone caring at all for history or romance? Or, where, as is of course usually the case, the true facts cannot be ascertained, probabilities can be weaved together and so the general history of its erection and early possessors can be arrived at, even if the actual individual ones cannot be perfectly "placed." A close study of any old building leads one into many paths, which throw side-lights on past ages, and on the people who lived therein. Sir Gilbert Scott says "The history of architecture is the history of civilization, for architecture unites and embraces the sister arts, and art is the visible exponent of civilization."

There are no counties in England and Wales which have not their grand old castles, though Monmouthshire is perhaps